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SUPPORTING MATERIAL ON THE MIN IATURIZED
ANTENNA TUNER

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ORIGINAL CL BY 235779
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CONFIDENTIAL**I. INTRODUCTION:**

It is the purpose of this document to propose the construction of a miniaturized HF antenna tuner and an auxiliary detector. The antenna tuner is similar to the tuner described in the proposal submitted March 3, 1961, except that certain of the auxiliary features have been removed. The auxiliary detector is a crystal controlled signal sensing device to be used as the tuner balance indicator in lieu of a conventional HF receiver.

25X1

II. OPERATIONAL DESCRIPTION:

The tuner described in this proposal is intended for operation in the 6-18 mc frequency range with transmitters having power outputs of 10 watts or less. The unit requires an external detector to supply the tuning indication. A conventional HF receiver or the auxiliary detector described later in this proposal may be used as to perform this function.

A block diagram of the tuner is shown in the sketch of figure one and as may be seen in this illustration, the tuner contains a matching network, a broadband noise generator and an impedance bridge. The antenna which is subsequently to be employed by the transmitter is connected to the impedance bridge through the matching network. The leg of the bridge which is complementary to the antenna is a 50 Ω resistor and a balanced condition is, therefore, obtained when the combined impedance of the antenna and matching network is precisely 50 ohms. A broadband low level

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noise source is employed as the signal source for the bridge and a narrow band external detector is used to select the particular portion of the frequency spectrum wherein the balance is to be obtained.

After a balance condition has been obtained as indicated by a signal null in the external detector, the tuner is switched to the transmitter and is ready for operation. It is assumed that the transmitter output impedance is 50Ω and no provisions for adjusting the transmitter are provided by the tuner.

The function of the external detector used in conjunction with the tuner bridge is to select a narrow band of noise at the frequency of interest and to amplify these signals to a sufficient level for aural monitoring. This function can be performed by any conventional narrow band receiver which has good sensitivity or with the compact auxiliary detector described in the following paragraphs.

The proposed auxiliary detector can be described as a zero IF superhetrodyne receiver. A block diagram of this device is shown in figure 2. The first stage of this device is a wide band RF amplifier which will accept and amplify all signals throughout the band of interest. The output the RF amplifier is applied to a balanced mixer where the signals are heterodyned with the output of the crystal controlled local oscillator. Since the input to the RF amplifier will consist mainly of noise extracted from the impedance bridge, the output of the balanced mixer is this same noise transposed in frequency. Noise occurring at the exact frequency of

the local oscillator will be transposed to a frequency of zero cycles. Noise occurring at some frequency removed from the local oscillator will appear at the output of mixer at a frequency corresponding to the difference between the local oscillator frequency and the noise frequency.

The balanced mixer is followed by a low pass filter which restricts the input to the audio amplifier to that portion of the noise spectrum which was initially (i.e. prior to the heterodyning process) located in a narrow band of frequencies centered about the local oscillator frequency. Since the audio amplifier will not pass DC, the band pass of the receiver has a double hump characteristic. The frequency separation between these humps is, however, so small in relation to the response curve of the antenna and tuner that the double hump response of the detector will not be noticeable in the operation of the unit. The low pass filter employed after the mixer will have a cut-off frequency between 1 and 2 KC. The low frequency 3 db points of the audio amplifier will be in the neighborhood of 200 cycles. Thus, the peaks in the detector response will, at worst, be separated by 4 KC with a fairly narrow (400 cycle) notch between the response peaks.

The detector will provide an overall gain of approximately 90 db so that the noise generator employed in the tuner may be operated at a very low level. Local oscillator radiation will be held to very low levels (anticipated to be below -60 dbm) by the following precautions.

1. The use of a balanced mixer.

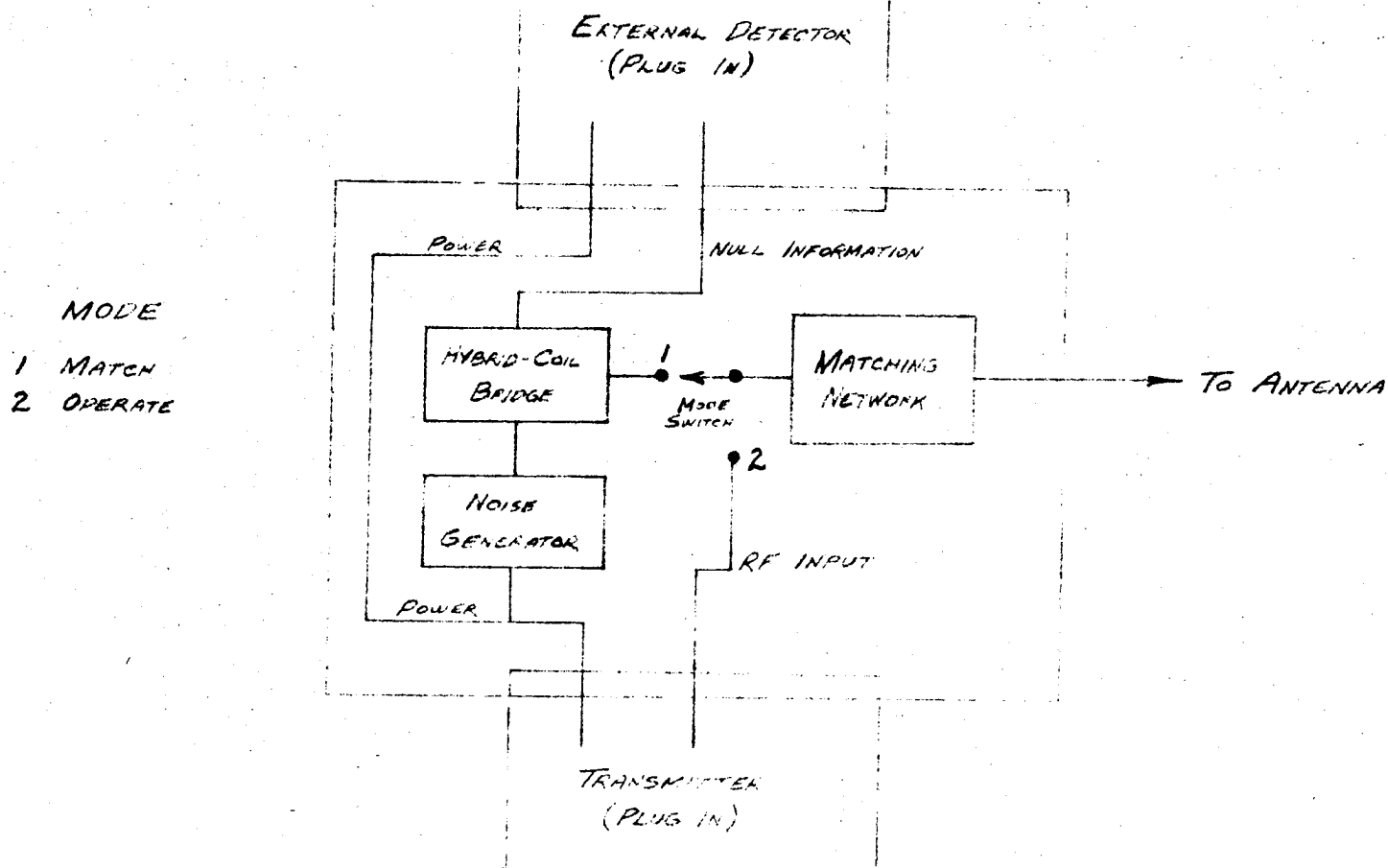
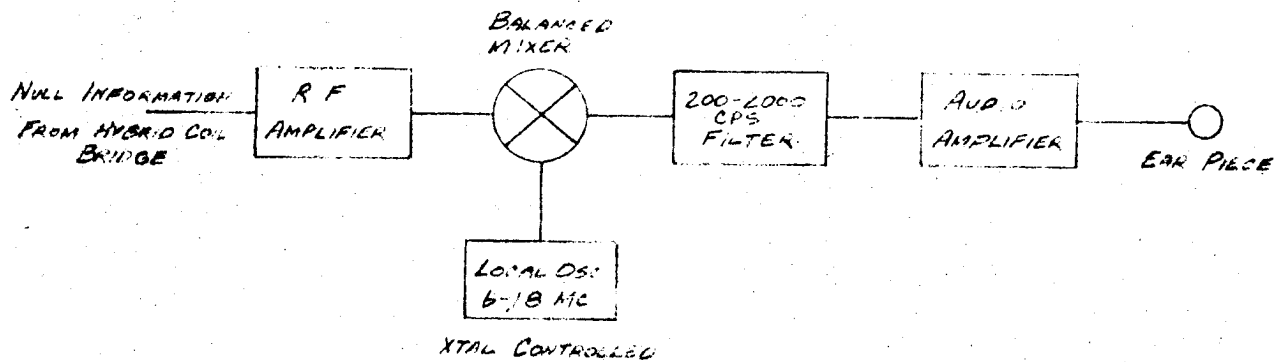
2. Minimum oscillator power for efficient mixing.
3. Adequate shielding and decoupling.
4. Preceding the mixer with two stages of RF isolation.
5. The use of a bridge configuration having ratio arms of 5 to 1 or better.

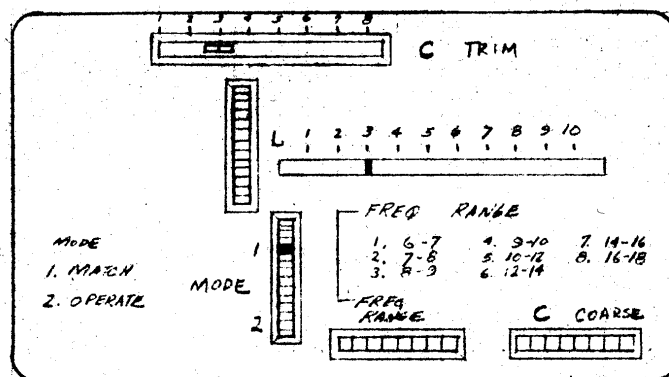
PHYSICAL CHARACTERISTICS:

A front panel layout of the tuner is shown in Figure 3.

The unit will be approximately 1 x 2 1/2 x 4 1/2 inches and will provide controls as shown in the layout.

The auxiliary detector will be approximately 1 x 2 1/2 x 3 1/2 inches. The local oscillator frequency will be determined by plug-in crystals which extend beyond the envelope quoted above. An "off" volume control is the only external control provided on the detector. Both the tuner and the detector will be designed to operate off of an external 12 volt supply.

FIGURE 1FUNCTIONAL BLOCK DIAGRAM OF TUNERFIGURE 2NULL DETECTOR



FRONT PANEL LAYOUT

(FULL SCALE)

DIMENSIONS 1 x 2 1/2 x 4 1/2 INCHES

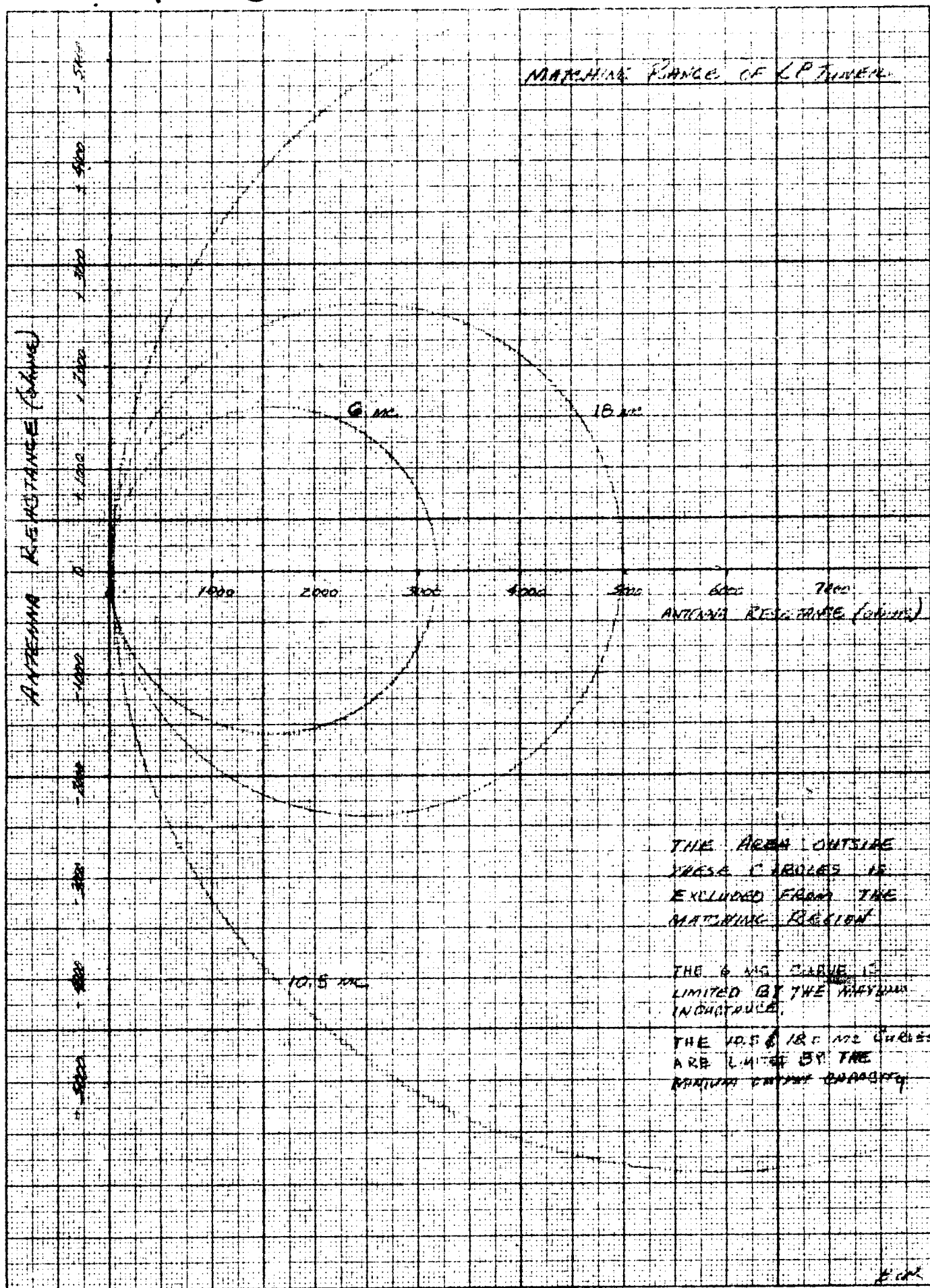
Letter dated 3-16-61

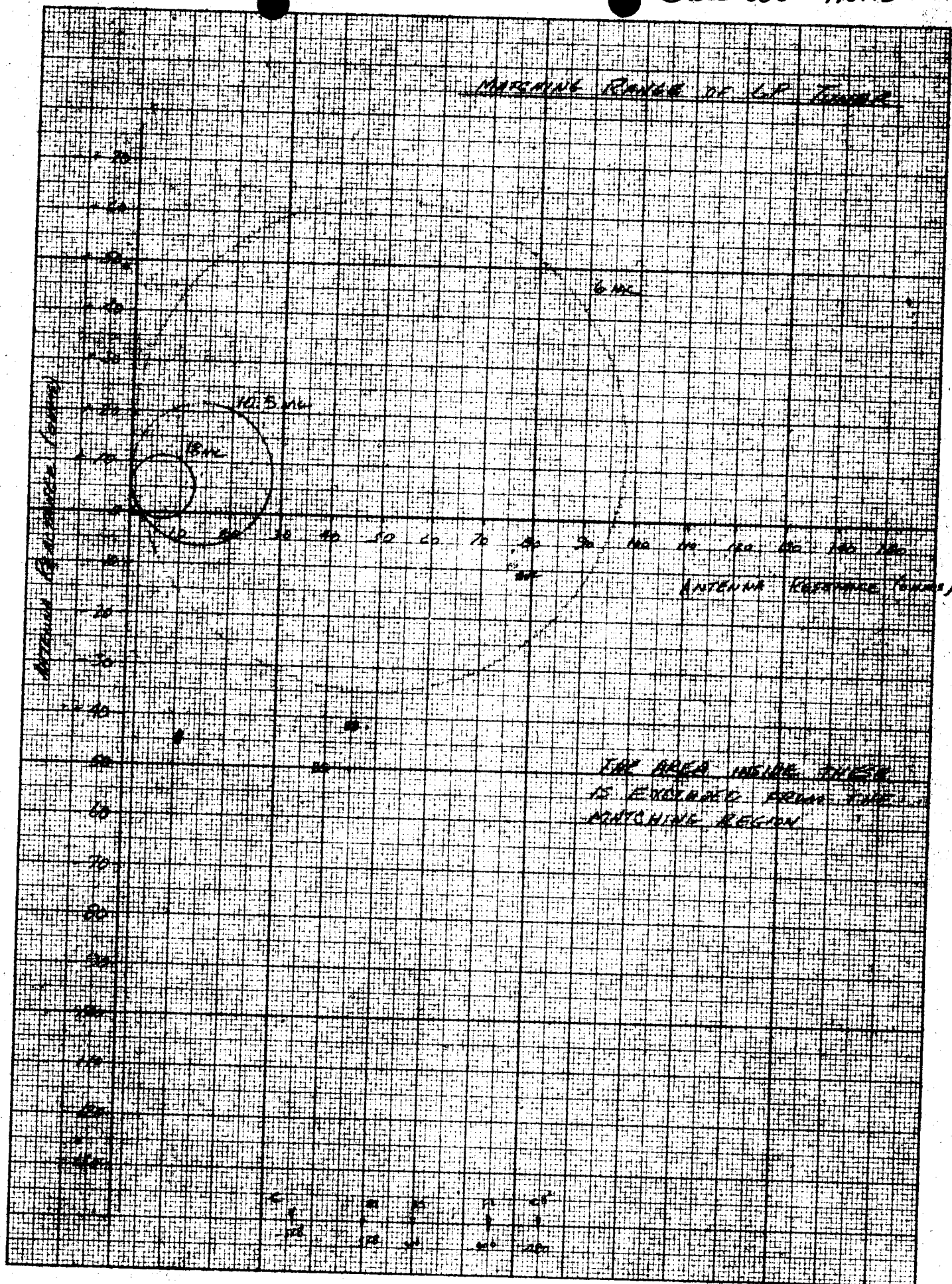
TITLE **MINIATURIZED ANTENNA TUNER (CPFF)**

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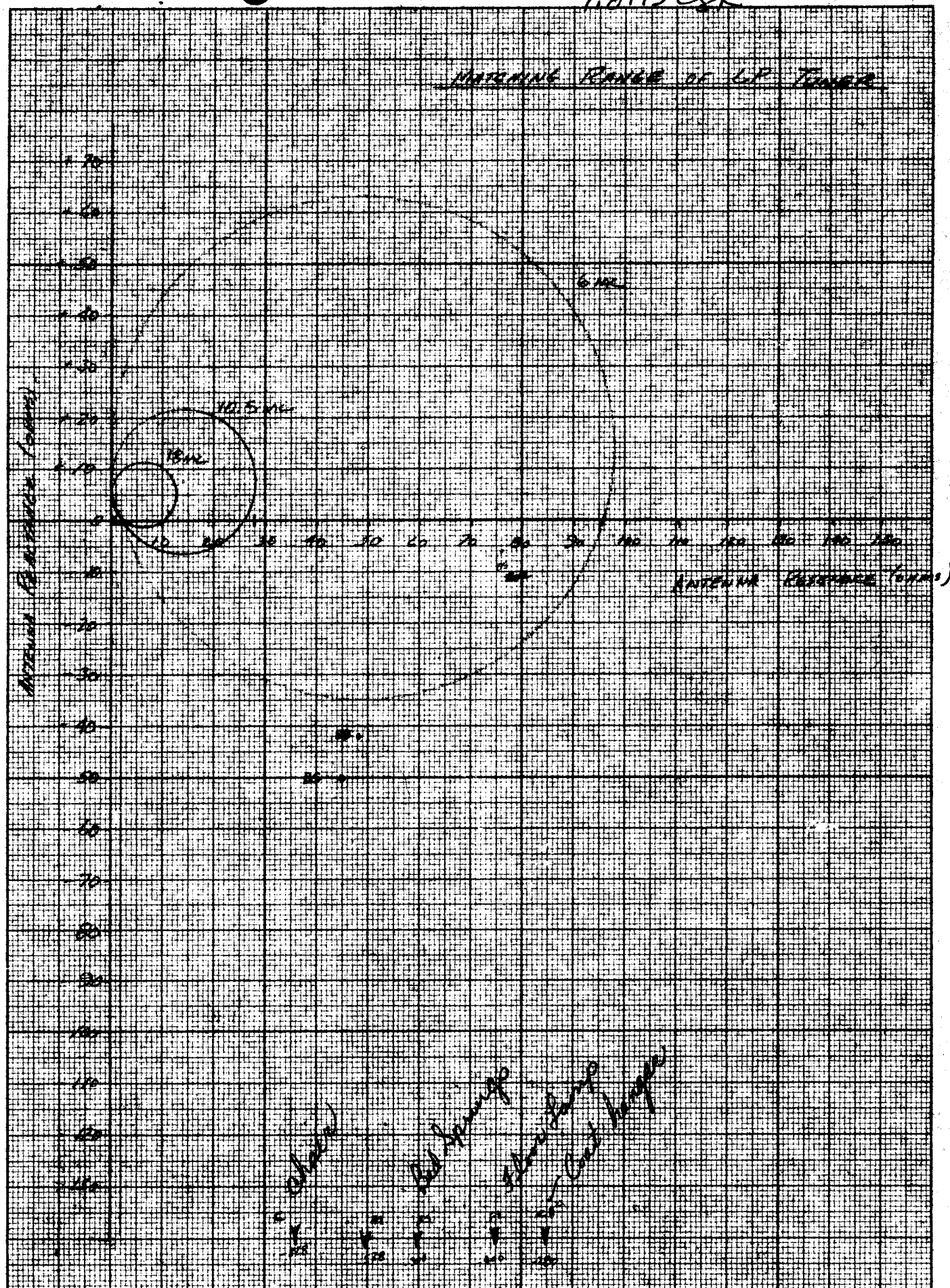
DATE **3-16-61**

			ITEM NO. 1. Build (1) Antenna Tuner		ITEM NO. 2. Build (1) Aux. Detector	
SALARIES & WAGES	J.C.	RATE	MAN HOURS	AMOUNT	MAN HOURS	AMOUNT
ENGINEERING:				\$		\$
Sr. Engr.		7.86	95	747		
Sr. Assoc. Engr.	5576	6.53			160	1045
Assoc. Engr.	5523					
Sr. Asst. Engr.	3524	4.99			800	3992
Asst. Engr.	3525	4.42	720	3182	400	1768
Jr. Asst. Engr.	3571					
Jr. Engr.	3526					
TOTAL ENGINEERING			815	\$ 3929	1360	\$ 6805
LAB. TECH.		3.31	425	1407	640	2560
PILOT LINE		2.42	35	85		
DRAFTING		2.90	205	595	80	232
MODEL SHOP		2.84	205	582		
PUBLICATIONS						
Tech Writing	VARIOUS	VARIOUS				
Illustrating	VARIOUS	VARIOUS				
Composing	VARIOUS	VARIOUS				
Cataloging	VARIOUS	VARIOUS				
Printing	VARIOUS	VARIOUS				
Photo Lab.	VARIOUS	VARIOUS			16	41
TOTAL PUBLICATIONS				\$	16	\$ 41
ENGR. DATA	VARIOUS	VARIOUS				
ENGR. SERVICES	VARIOUS	VARIOUS	80	268		
MISC. FACTORY	VARIOUS	VARIOUS			16	32
TOTAL SALARIES & WAGES			1765	\$ 6866	2112	\$ 9670
DEPT. OVERHEAD						
Engineering				5108		8847
Lab. Tech.				563		1024
Pilot Line				60		
Drafting				327		128
Model Shop				477		
Publications						46
Engr. Data						
Engr. Services				442		
Misc. Factory						55
TOTAL DEPT. OVERHEAD				\$ 6977		\$10,100
MATERIALS				500		300
TRAVEL & EXPENSES						
SUB. TOTAL				\$ 14,343		\$20,070
G & A. EXPENSE @ 9%				1,291		1,806
GEN. RESEARCH @ 4%				574		803
TOTAL ESTIMATED COST				\$ 16,208		\$22,679
FIXED FEE @ 8%				1,297		1,814
TOTAL EST. COST PLUS FIXED FEE				\$ 17,505		\$24,493

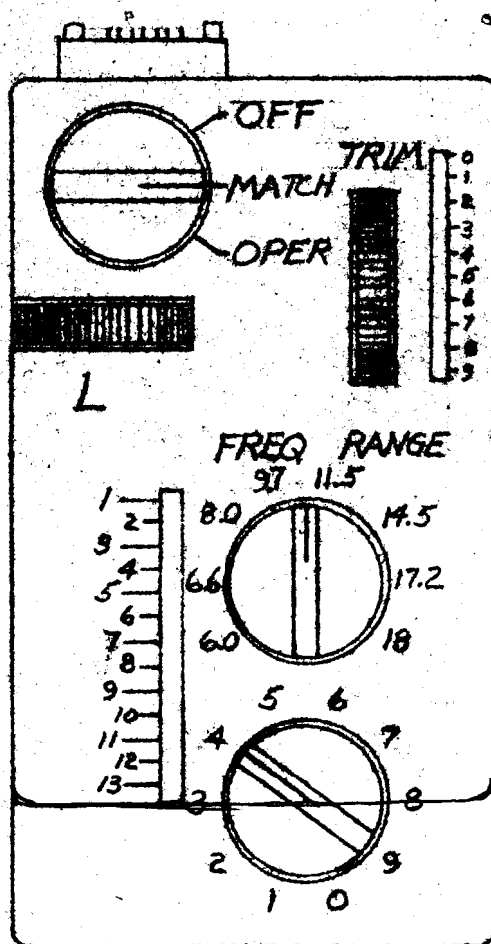


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Plug - discussed or not?

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now counting up to 20⁺ mc.

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